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# METHOD AND DEVICE FOR PRODUCING LIGHT-METAL PELLETS

Background of the Invention

The invention relates to a method according to the preamble of Claim 1 and a device for working this method.

German patent DE PS 823 778 discloses such a method and device for light and heavy metals, while DE PS 1 508 800 relates to very high-melting-point materials such as uranium carbide.

According to the invention, the term "pellets" signifies not only particles which are produced from a solid base material such as sintered compact produced from powder, but also as used herein specifically comprises particles which have been produced from liquid material. In contrast to the term "granulate" which may have an essentially irregular shape, the term "pellets" which have by comparison a much more uniform shape is used according to the invention. The following discussion deals specifically with the production of magnesium pellets, however, the invention is not restricted to the material magnesium.

Where the workpieces fabricated from the pellets, e.g., cast or injection-molded workpieces, are components subject to high stresses or loads, reinforcing materials such as fibers, particles or similar additives may be added to the light metal, which additives are designed to enhance, for example, the resistance of the workpiece to abrasion, fracture, bending, or its fatigue strength under vibratory stress. The workpiece may be excessively weakened, however, if these additives are unevenly distributed within the workpiece allowing undesirable voids to form.

Summary of the Invention

The object of the invention is to improve a generic method to reliably assist in achieving the most uniform characteristics possible for the workpiece fabricated from the pellets, and to provide a device suited to this purpose.

~~This fundamental object of the invention is achieved by a method with the characteristic features of Claim 1. Devices suitable for implementing the method are found in Claims 6 through 9.~~

The invention proposes, in other words, adding fibers, particles or similar additives to the molten light metal so that instead of adding such additives only at the stage of the injection or casting mold, the pellets already contain the additives at the

time of subsequent processing. This approach ensures a uniform distribution of the additives which help to preclude additive voids within the workpiece.

The method provides for producing the generated, solidified material in a form so thin that it may be reduced easily and with low input of energy – with the result that due to the low material thickness and resulting ease of reduction, pellets of precise dimensions may be produced. This result may be achieved by generating rod or wire material of extremely small cross-sectional dimensions called "spaghetti."

Provision can be made that a body exiting the cooling body be generated consisting of connected pellets and that this body only later be separated into individual pellets. This approach allows for the space-saving transport of the pellets in which these are incorporated in a waffle, mat or sheet, or rolled-up strip. This type of transport may eliminate the need for repackaging which would be required for separate pellets, e.g. in cartons or bags. In addition, this approach facilitates the precise metering of the connected pellets when they are fed into a processing machine since, for example, the strip may be unrolled pellet by pellet, or the sheet may be fed in stages.

Separation into separate individual pellets may be disconnected both by location and time from the production of such bodies, e.g., in a special reduction unit placed upstream from the processing machine, or reduction may be performed by feeding the sheet or strip into the processing machine where these are broken up into individual pellets by a screw conveyor provided in the machine, this process being facilitated by attenuation lines.

The molten light metal is passed between two cooling bodies which form a narrow gap in which the cooling effect is especially intensive, a function of the quantity of molten metal adjacent to the cooling bodies, and in which the light metal may be stamped or cut. Solidification may proceed here at least at the surface of the material to the extent of generating an enclosed skin and thus providing shape.

In addition to effecting the process by regulating the speed of the two cooling bodies, a controlled management of molten metal or solidifying pellets may be achieved by controlling the cooling of the two cooling bodies, e.g., by means of a cooling medium passing through the cooling bodies.

Further complete solidification may be achieved by cooling in air, assisted as required by blowing with compressed air, or by passing the at least partially solidified material into a cooling fluid, or by subjecting it to a drip or spray of cooling fluid. Especially intense cooling may be provided so as to intentionally generate material at the most brittle level possible, thereby facilitating subsequent breakup given the above-described situation in which the pellets are fabricated as one continuous body.

It is advantageous to have the cooling bodies be synchronously movable such that the light metal is not simply fed through subject to the friction of the cooling bodies but the cooling bodies simultaneously form a transport device for the light metal. By employing a rounded or beveled shape or arrangement for the cooling bodies, a receiving chamber is created for the molten light metal, this chamber subsequently leading to the afore-mentioned gap. The shaping of the liquid or partially solidified light molten light metal, or the complete separation of light metal either partially or completely solidified, may take place in this gap.

It is advantageous to design the cooling bodies as two adjacent wheels or rollers, the circumferential faces of which are placed very close together or are even in contact. This design forms a funnel between the two cooling bodies such that, in a single operation, the liquid molten magnesium may be fed into this funnel, then passed by the moving cooling bodies into the gap between both cooling bodies, and there shaped or divided. As the two cooling bodies move further, their two surfaces again separate, thereby allowing the magnesium pellets to drop or the magnesium strip provided with attenuation lines to be passed downward where it is easily reduced to pellets of a standardized size.

If required, the surface of both rollers may be designed such that both forms of material separation are provided. Predetermined sections of the roller surface may receive the form of a continuous strip, waffle, mat or the like with pellets, an actual separation ridge being provided in the surface of the roller so that mats, waffles, strips or the like of predetermined size containing the pellets are produced rather than an endless strip, mat or the like. For this purpose, the separating ridge may effect a complete material break in the molten metal or pellets produced such that the dimensions of these continuous pellet arrangements are limited and preset. Especially advantageous is the fact that if the pellets do not require immediate processing in a melting unit, these continuous pellet arrangements of predetermined dimensions allow for easy subsequent

handling, for example, automated packing of these "clusters," either individually or multiply in a packing unit.

An alternative to the design using two wheels is one using a link-chain-type or conveyor-belt-type design for the two cooling bodies, thereby easily creating a comparatively long gap in which the two cooling bodies are adjacent to one another and creating an intensive cooling and solidification effect, and also achieving a correspondingly high throughput.

Brief Description of the Drawings

The following discussion presents embodiments of the invention in more detail based on the drawing.

Fig. 1 shows in schematic form an initial embodiment of a device for producing magnesium pellets.

Fig. 2 shows, also in schematic form, a second embodiment of a device for producing magnesium pellets.

Description of Illustrated Embodiment

Fig. 1 shows two roller-shaped cooling bodies 1 where funnel 2 is provided for above and between both cooling bodies 1 to feed molten light metal 3 which is designated hereafter as molten magnesium simply as an example. The two cooling bodies 1 are driven counter-rotationally and synchronously relative to one another, and may be cooled by a cooling unit not shown. The magnesium solidifies at the surface of cooling bodies 1, and when molten magnesium 3 enters gap 4, created as a narrowing between both cooling bodies 1, a narrow magnesium strip 5 is produced which has solidified sufficiently at least at its outer surface to allow it then to be drawn from the device.

Shown schematically on magnesium strip 5 are attenuation lines 6 which have been stamped into magnesium strip 5. These attenuation lines 6 are generated by ridges 7 shown schematically which are provided on the surfaces of cooling bodies 1.

For the sake of simplifying the drawing, no concavities or projections are visible on the edge of magnesium strip 5 and cooling bodies 1; and additionally, attenuation lines 6 and ridges 7 are drawn as straight and continuous, thus producing rectangular pellets. Other pellet forms of differing shape are possible and may be chosen

specifically as appropriate to the alloy composition of the molten metal selected and the intended application of the pellets.

Attenuation lines 6 establish defined fracture lines of magnesium strip 5 so that magnesium strip 5 may be processed, using little energy, to create pellets 8 in a downstream crushing or deformation device not shown. Magnesium strip 5 simply represents a connected arrangement of these pellets 8 before these pellets 8 are subsequently broken up.

Alternatively, ridges 7 may project far enough above cooling bodies 1 that interacting with the surface of each opposing cooling body 1 or with a ridge 7 of the other cooling body, a complete separation of the magnesium is effected such that, below gap 4, individual separated pellets 8 fall from the device rather than a continuous magnesium strip 5 being created.

A further alternative embodiment has depressions rather than ridges 7 on the surface of the cooling bodies. The depressions of the two cooling bodies 1 here function as molds, and as a result, pellets are generated, the form of which is determined by the shape of the depressions.

A possible feature here is to allow residual amounts of magnesium to remain between individual depressions similar to a thin skin so that the pellets generated remain connected as they exit the device. This connection may be desirable if it is advantageous for subsequent handling, e.g., if pellets must be individually metered and precisely fed into the casting machine. Provision may be made, however, to immediately remove the pellets formed in the depressions from the device so that they are ready for immediate processing and may either be packaged or processed in a casting machine.

Fig. 2 shows a second embodiment in which both cooling bodies 1 are of link-chain or conveyor-belt design and move around two guide rollers 9. This approach creates a comparatively long gap 4. The device in Fig. 2 is arranged horizontally to save overall height. Unlike this embodiment, however, a device of analogous design may also be arranged vertically so that the movement of the magnesium is gravity-assisted. As with the device in Fig. 1, the actual cooling device for the device of Fig. 2 is not shown in detail for reasons of clarity.

The long gap 4 of the embodiment in Fig. 2 allows for a high throughput for this device due to the high cooling performance obtainable. During the design phase for this device, it is a simple matter to specify the desired degree of partial or complete solidification for the magnesium based on the appropriate length of cooling bodies 1, whereas with the embodiment of Fig. 1 the circumferential speed of the two roller-shaped cooling bodies 1 is limited by the specified degree of solidification.

As explained above, the surface design of cooling bodies 1 in the embodiment of Fig. 2 may be created with projecting ridges 7 or molded depressions, as indicated schematically, and in this embodiment of a device according to the invention as well, the final separation of the individual pellets may be achieved in the device itself or subsequently in a specially provided crusher along the appropriate attenuation lines 6 which are indicated schematically.

In the devices of both Fig. 1 and Fig. 2, an additional feed unit, e.g., for granular or powder-type particles or fibers may be provided. Examples of possible granular or powder-type particles are those of SiC, $Al_2O_3$, or carbon. The method of feed for the particles or fibers may be to add these to the molten metal or to add them to the molten metal up to a point immediately before gap 4 such that a specified distribution of particles or both fibers and molten magnesium is assured – and thus the consistency of the product as well. Fibers may as required by added in loose form as bulk material, or as nonwoven, woven or knit material, or in analogous form such that this method of adding the fibers ensures especially uniform product characteristics for the fiber-containing pellets. An especially advantageous method may be to homogenously distribute the particles or fibers at an external site, e.g., by mechanical or induction stirring.